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STATEMENT OF THE FEDERAL AVIATION ADMINISTRATION, BEFORE THE COMMITTEE ON MERCHANT MARINE AND FISHERIES, AD HOC SELECT SUBCOMMITTEE ON MARITIME EDUCATION AND TRAINING, CONCERNING SIMULATOR TRAINING. SEPTEMBER 9, 1980.

Mr. Chairman and Members of the Subcommittee:

The Federal Aviation Administration is pleased to have the opportunity to discuss the use of simulators in aviation in order to aid the Subcommittee in its study of the use of simulators in sea training.

As the state-of-the-art in simulator technology has advanced, more effective use has been made of the aircraft simulator in both the training and checking of flight crewmembers. The increasing complexity and operating costs of the modern turbojet and its operating environment point to greater use of the advanced technology now available in aircraft simulators. Simulators can provide more in-depth training than can be accomplished in the aircraft. There is also a very high percentage of transfer of learning from the simulator to the aircraft. The additional use of simulators in lieu of the aircraft results in safer flight training, great cost reductions for the operators, and achieves the benefit of fuel conservation and a decrease in noise pollution.

During the last 25 years, as simulator technology has improved, changes to the Federal Aviation Regulations (FAR) have been

made to allow the increased use of simulators in air carrier training programs. FAA acknowledgment of the value of simulator training began in 1954 when air carriers were allowed to perform all but four proficiency check maneuvers in a simulator. From this beginning, the FAA has continued to promote, evaluate, and regulate the use of simulation in aviation.

In the late 1960's, visual attachments appeared on the market. Since that time, a breakthrough in computerization has permitted the development of computer-generated image visual systems. In December 1973, amendments to the FAR permitted a simulator approved for the landing maneuver to be substituted for the aircraft in a pilot recency of experience qualification. These changes to the FAR constituted a significant step towards the development of the new amendment issued on June 24, 1980, which contains the FAA Advanced Simulation Plan. The new FAA rule outlines a three-step program for airlines to follow in upgrading their flight simulation capabilities to a point where nearly all required training activities and check rides can be carried out in advanced simulators. However, only experienced airline pilots will be allowed to participate in the advanced simulation plan.

Historically, pilot flight training requirements have been concentrated in a list of specific maneuvers and procedures required to be performed by a pilot on an individual basis. Examples include stalls, steep turns, various types of instrument approaches and landings. These maneuvers and procedures are fully set out in Appendices E and F to Part 121 of the FAR, which are enclosed for reference. Under this training philosophy, the measurement of an individual's capability to safely maneuver an aircraft has been how well he or she performs in these maneuvers and procedures. However, a recent study of airline accidents which involved pilot error seems to indicate that the pilot's ability to perform the skills required to physically maneuver the aircraft was not a factor. Rather, it seems that a lack of coordination between members of the flightcrew, and the failure to properly evaluate and manage an abnormal situation, were the primary factors which ultimately led to the accidents. So it would appear that the training needs of the airline pilot go beyond teaching that pilot the proper techniques, and physical skills to maneuver an aircraft.

The airline pilot is also required to receive training in how to perform as a part of a team--the team being the entire aircraft crew. We call this type of training "crew concept" training. By far, the most effective method of employing crew

concept training is through line oriented flight training (LOFT) which was recently introduced into the FAR. Under LOFT, an entire flightcrew is placed in a simulator, and is required to perform as a team through a flight segment which has been programmed into the simulator. During the flight segment, certain simulated abnormal and emergency situations are introduced, and the crew is required to deal with those situations without outside help from an instructor. LOFT has proved to be a very effective means of providing the extra training needed by an airline pilot to deal with situations requiring abilities beyond physically flying the aircraft. Realism in simulation is essential to the success of LOFT. If a simulator does not represent the physical and flight characteristics of the actual aircraft, and if the visual system does not adequately represent the flight environment, the flightcrew will not function as they would in a "real world" situation. This is why the FAA has placed such a great emphasis on the advancement of simulator technology.

The FAA's advanced simulation plan can be briefly outlined as follows:

The first phase of the plan can be conducted in existing simulators which have been upgraded to Phase I standards. Phase I permits pilots to meet various training requirements in simulators. This includes the "recency of experience" requirement, which specifies that pilots must have a minimum of

three takeoffs and landings within a 90-day period to rem qualified in a particular aircraft. Phase I also permits pilots to complete periodic proficiency checks which are required every 6 months for captains and 12 months for co and flight engineers in simulators approved under Phase I.

The second phase will require substantial simulator improvements, most of which are already achieveable. Amon other things, simulators must be programmed for crosswind a wind shear effect, a variety of runway conditions, and brak and tire failure. Each Phase II simulator must be equipped with a six-axis motion system (pitch, roll, yaw, surge, swa and heave). Also, visual systems must include dusk, as wel night scenes, improved weather presentations, and an expande field of view of 75^{o} horizontal and 30^{o} vertical from each pilot position.

In this second phase, pilots will be allowed additional training and checks in simulators. For example, pilots can u simulators to transition from one airplane to another in the same group, e.g. from copilot of a Boeing 727 to copilot of a Boeing 707. It also will permit pilots to upgrade from copilot to pilot-in-command in the same aircraft type. The third phase will permit nearly all training and check ride to be conducted in simulators approved under that phase,

including initial training for pilots who have not f
certain type of airplane before.

Implementation of this final phase will require addi
development by simulator manufacturers to produce equ
that can duplicate virtually every aspect of the real
flight. For example, the simulator must be programme
incoporate characteristic buffet motions, such as whe
landing gear is extended or flaps deployed; realistic
sounds and noises; and various inflight phenomena such
ground effect at low altitude and the effects of airfr
icing. Visual systems also will need further upgradin
include realistic daylight presentations, special weat
representations, and the capability for realistic protr
specific airport scenes.

FAA expects the new rules to stimulate airlines to upgr
their simulators to take full advantage of their capabi
in meeting training requirements. There are many advant
the use of simulators in aviation training. It reduces
number of training flights, with a corresponding reducti
accidents, fuel consumption, and aircraft noise. The fu
savings alone are estimated to range from 32 million to
million gallons depending on how extensively the airlines
utilize simulators. The greatest advantage of simulator

training is that this equipment can provide operational experience in normal operating procedures, abnormal operating procedures, emergency procedures, any weather condition, any lighting condition, any airport location, and training situations which would be impossible or unsafe to conduct in a real aircraft in flight, such as wind shear or a blown tire on landing.

A review of accident data shows that the cause of most accidents is lack of pilot experience in dealing with abnormal flight situations, rather than the pilot's inability to control the aircraft or perform specific maneuvers. Thus simulator training can enhance safety by providing experience in these abnormal flight situations, which could not be obtained in the actual aircraft. In addition, simulator training can be utilized 24 hours a day, 365 days a year, in any building large enough to hold the equipment. All of this adds up to training flexibility with maximum safety.

We have only discovered two possible drawbacks to the use of simulators. The first is that if the simulation is not good, training on the simulator can be counterproductive, either by teaching the pilot bad habits or by instilling in the pilot a false sense of confidence. This problem can be eliminated by ensuring that the simulators do in fact reproduce reality, both

in terms of external conditions and the responsiveness of the "aircraft." For this reason, the FAA has published extensive requirements for simulators in FAR §121.407 and Appendix H to Part 121.

The other possible drawback is the high procurement cost of a sophisticated simulator. An advanced simulator can easily cost $4 to $6 million. For a major airline with many pilots to train on expensive aircraft, the reduction in the number of aircraft that need to be diverted to training flights and the concommitant savings in fuel will more than offset the expense of procuring the simulator. For smaller companies training pilots in less sophisticated aircraft, the cost of owning an advanced simulator may be prohibitive. Where small numbers of a particular type of aircraft are in operation, simulators may not currently exist. For this reason, the FAA has never <u>required</u> the use of simulators. Rather our regulations have always been <u>permissive</u>, allowing the operator to substitute the use of approved simulators for flight training and checking if the operator so chooses. Naturally, an operator will not opt to purchase a simulator unless it does not exceed the cost of the flight training in the aircraft. However, all operators of large Turbojet aircraft today either own their own simulator or lease simulator time from other operators.

A copy of our June 30 rule on the use of advanced simulation has been attached to this statement for the Subcommittee's information. The FAA will be pleased to provide the Subcommittee with any further information which would assist in its inquiry.